AMENDMENTS TO THE CLAIMS

1. (Currently amended) A pixel cell comprising:

a photo-conversion device;

a sensing node; and

a first transistor for gating charge from said photo-conversion device to said sensing node; said first transistor comprising a gate electrode having a length and a width, and a channel region under said gate electrode,

said width of said gate electrode extending from said photo-conversion device to said sensing node,

said length of said gate electrode being divided into a plurality of gate electrode regions, wherein at least one said gate electrode region has a work-function greater than a work-function of n+ Si, and another said gate electrode region has a different work-function from that of said at least one gate electrode region,

said channel region comprising respective portions below each gate electrode region, wherein a doping concentration of at least one portion of said channel region is determined in part by the work-function of the respective gate electrode region.

~~adjacent to the photo-conversion device, the first transistor comprising a gate electrode and a channel region under the gate electrode, the gate electrode having a length extending from a source/drain region to the photo-conversion device and comprising at least one gate electrode region extending the length of the gate electrode and having a substantially uniform dopant type and concentration and a work-function greater than a work-function of n+ Si, the channel region comprising at least one channel portion under the at least one gate electrode region.~~

2. (Original) The pixel cell of claim 1, wherein the first transistor is a transfer transistor for transferring photo-generated charge from the photo-conversion device to a floating diffusion region.

3. (Previously presented) The pixel cell of claim 1, wherein at least one gate electrode region comprises a mid-gap material.

4. (Original) The pixel cell of claim 3, wherein the mid-gap material is selected from the group consisting of: $Si_{1-x}Ge_x$, TiN/W, Al/TiN, Ti/TiN, and TaSiN.

5. (Original) The pixel cell of claim 3, wherein the mid-gap material is $Si_{1-x}Ge_x$, and wherein the mole fraction of Ge in the $Si_{1-x}Ge_x$ is approximately 0.4.

6. (Previously presented) The pixel cell of claim 5, wherein the at least one gate electrode region is doped to one of a first or second conductivity type.

7. (Previously presented) The pixel cell of claim 1, wherein at least one gate electrode region comprises a degenerately doped p+ polysilicon layer.

8. (Previously presented) The pixel cell of claim 1, wherein at least one gate electrode region comprises a layer of lower doped polysilicon of a first or second conductivity type.

9. (Previously presented) The pixel cell of claim 8, wherein at least one gate electrode region has a dopant profile allowing for at least partial depletion of the at least one gate electrode region.

10. (Original) The pixel cell of claim 8, wherein the dopant is indium.

11. (Original) The pixel cell of claim 1, wherein there is approximately no active dopant in at least one portion of the channel region.

12. (Currently amended) The pixel cell of claim 1, further comprising:

a second transistor formed ~~over the substrate~~ adjacent said sensing node, wherein the second transistor comprises a gate electrode, the gate electrode comprising at least one gate electrode region having a work-function greater than a work-function of n+ Si.

13. (Previously presented) The pixel cell of claim 12, wherein at least one second transistor gate electrode region is formed of a same material as the at least one gate electrode region.

14. (Withdrawn) The pixel cell of claim 1, wherein the first transistor comprises first and second gate electrode regions and first and second channel portions under the first and second gate electrode regions, respectively.

15. (Withdrawn) The pixel cell of claim 14, wherein each of the first and second gate electrode regions extends over an active area by a different distance.

16. (Withdrawn) The pixel cell of claim 14, wherein the first and second gate electrode regions have different work-functions, and wherein each work-function is greater than a work-function of n+ Si.

17. (Withdrawn) The pixel cell of claim 14, wherein the first and second gate electrode regions comprise a same material having different doping characteristics.

18. (Withdrawn) The pixel cell of claim 1, wherein the first transistor comprises first, second, and third gate electrode regions and first, second, and third channel portions under the first, second, and third gate electrode regions, respectively.

19. (Withdrawn) The pixel cell of claim 18, wherein the first gate electrode region is between the second and third gate electrode regions, and wherein the second and third gate electrode regions are each over a respective area where an isolation region and an active region meet, and wherein at least one of the second

and third gate electrode regions has a work-function greater than a work-function of n+ Si.

20. (Withdrawn) The pixel cell of claim 19, wherein the second and third gate electrode regions have a same work-function.

21. (Withdrawn) The pixel cell of claim 19, wherein the doping concentration of at least one of the second and third channel portions is determined at least in part by the work-function of the respective gate electrode region.

22. (Withdrawn) The pixel cell of claim 19, wherein the first gate electrode region is formed of a different material than the second and third gate electrode regions.

23. (Withdrawn) The pixel cell of claim 19, wherein the first, second, and third gate electrode regions are formed of a same material having different doping characteristics.

24. (Canceled)

25. (Withdrawn) A pixel cell comprising:

a photo-conversion device at a surface of a substrate; and

a transistor formed over a substrate and adjacent to the photo-conversion device, the transistor comprising a gate electrode overlying a channel region, the gate electrode having a length extending from a source/drain region to the photo-

conversion device and the gate electrode comprising at least two gate electrode regions, each gate electrode region extending the length of the gate electrode and having a substantially uniform dopant type and concentration, wherein at least one of the gate electrode regions has a work-function greater than a work-function of n+ Si, the channel region comprising respective portions below each gate electrode region.

26. (Withdrawn) The pixel cell of claim 25, wherein each gate electrode region extends over an active area by a different distance.

27. (Withdrawn) A pixel cell comprising:

a photo-conversion device at a surface of a substrate; and

a transistor formed over a substrate and adjacent to the photo-conversion device, the transistor comprising a gate electrode overlying a channel region, the gate electrode comprising first, second, and third gate electrode regions, wherein the first gate electrode region is between the second and third gate electrode regions, and wherein the second and third gate electrode regions are over an area where an isolation region and an active region meet, and wherein at least one of the second and third gate electrode regions has a work-function greater than a work-function of n+ Si, the channel region comprising first, second, and third portions below each gate electrode region, respectively.

28. (Withdrawn) The pixel cell of claim 27, wherein the second and third gate electrode regions have a same work-function.

29. (Withdrawn) The pixel cell of claim 27, wherein a doping concentration of at least one of the second and third channel portions is determined at least in part by the work-function of the respective gate electrode region.

30. (Currently amended) An image sensor, comprising:

~~a substrate;~~

an array of pixel cells, wherein each pixel cell comprises:

a photo-conversion device,

a floating diffusion region, and

a transistor for gating charge from said photo-conversion device to said floating diffusion region, said transistor comprising a gate electrode having a length and a width, and a channel region under said gate electrode,

said width of said gate electrode extending from said photo-conversion device to said floating diffusion region,

said length of said gate electrode being divided into a plurality of gate electrode regions, wherein at least one said gate electrode region has a work-function greater than a work-function of n+

Si, and another said gate electrode region has a different work-function from that of said at least one gate electrode region,

said channel region comprising respective portions below each gate electrode region, wherein a doping concentration of at least one portion of said channel region is determined in part by the work-function of the respective gate electrode region.

~~a transistor formed adjacent to a photo-conversion device, the transistor comprising a gate electrode and a channel region under the gate electrode, the gate electrode having a length extending from a source/drain region to the photo-conversion device and comprising at least one gate electrode region extending the length of the gate electrode and having a substantially uniform dopant type and concentration and a work-function greater than a work-function of n+ Si, the channel region comprising at least one channel portion under the at least one gate electrode region.~~

31. (Original) The image sensor of claim 30, wherein the image sensor is a CMOS image sensor.

32. (Original) The image sensor of claim 30, wherein the image sensor is a charge coupled device image sensor.

33. (Currently amended) The image sensor of claim 30, wherein the transistor is a transfer transistor~~ for transferring photo-generated charge from the photo-conversion device to a floating diffusion region~~.

34. (Previously presented) The image sensor of claim 30, wherein at least one gate electrode region comprises a mid-gap material.

35. (Original) The image sensor of claim 34, wherein the mid-gap material is selected from the group consisting of: $Si_{1-x}Ge_x$, TiN/W, Al/TiN, Ti/TiN, and TaSiN.

36. (Original) The image sensor of claim 35, wherein the mid-gap material is $Si_{1-x}Ge_x$, and wherein the mole fraction of Ge in $Si_{1-x}Ge_x$ is approximately 0.4.

37. (Previously presented) The image sensor of claim 36, wherein the least one gate electrode region is doped to one of a first or second conductivity type.

38. (Previously presented) The image sensor of claim 30, wherein at least one gate electrode region comprises a degenerately doped p+ polysilicon layer.

39. (Previously presented) The image sensor of claim 30, wherein at least one gate electrode region comprises a layer of lower doped polysilicon of a first or second conductivity type.

40. (Previously presented) The image sensor of claim 39, wherein the at least one gate electrode region has a dopant profile allowing for at least partial depletion of the at least one gate electrode region.

41. (Original) The image sensor of claim 30, wherein there is approximately no active dopant in at least one portion of the channel region.

42. (Withdrawn) The image sensor of claim 30, wherein the transistor comprises first and second gate electrode regions and first and second channel portions below the first and second gate electrode regions, respectively.

43. (Withdrawn) The image sensor of claim 42, wherein the first and second gate electrode regions each extend over an active area by a different distance.

44. (Withdrawn) The image sensor of claim 42, wherein the first and second gate electrode regions have different work-functions, and wherein each work-function is greater than a work-function of n+ Si.

45. (Withdrawn) The image sensor of claim 30, wherein the transistor comprises first, second, and third gate electrode regions and first, second, and third channel portions below the first, second, and third gate electrode regions, respectively.

46. (Withdrawn) The image sensor of claim 45, wherein the first gate electrode region is between the second and third gate electrode regions, and wherein the second and third gate electrode regions are each over a respective area where an isolation region and an active region meet, and wherein at least one of the

second and third gate electrode regions has a work-function greater than a work-function of n+ Si.

47. (Withdrawn) The image sensor of claim 46, wherein the second and third gate electrode regions have a same work-function.

48. (Withdrawn) The image sensor of claim 46, wherein the doping concentration of at least one of the second and third channel portions is determined at least in part by the work-function of the respective gate electrode region.

49. (Currently amended) A processor system, comprising:

(i) a processor; and

(ii) an image sensor coupled to the processor, the image sensor comprising:

~~a substrate;~~

a pixel comprising:

a photo-conversion device,

a sensing node, and

a transistor for gating charge from said photo-conversion device to said sensing node, said transistor comprising a gate electrode having a length and a width, and a channel region under said gate electrode,

said width of said gate electrode extending from said photo-conversion device to said sensing node,

the length of said gate electrode being divided into two gate electrode regions, wherein one said gate electrode region has a work-function greater than a work-function of n+ Si, and another said gate electrode region has a different work-function from that of said one gate electrode region,

said channel region comprising respective portions below each gate electrode region, wherein a doping concentration of at least one portion of said channel region is determined in part by the work-function of the respective gate electrode region.

~~and a transistor, the transistor comprising a gate electrode and a channel region under the gate electrode, the gate electrode having a length extending from a source/drain region to the photo-conversion device and comprising at least one gate electrode region extending the length of the gate electrode and having a substantially uniform dopant type and concentration and a work-function greater than a work-function of n+ Si, the channel region comprising at least one channel portion under the at least one gate electrode region.~~

50. (Original) The system of claim 49, wherein the image sensor is a CMOS image sensor.

51. (Original) The system of claim 49, wherein the image sensor is a charge coupled device image sensor.

52. (Currently amended) A method of forming a pixel cell, the method comprising:

forming a photo-conversion device;

forming a sensing node; and

forming a first transistor for gating charge from said photo-conversion device to said sensing node; the act of forming said first transistor comprising forming a gate electrode having a length and a width, and forming a channel region under said gate electrode,

said width of said gate electrode extending from said photo-conversion device to said sensing node,

said length of said gate electrode being divided into a plurality of gate electrode regions, wherein at least one said gate electrode region has a work-function greater than a work-function of n+ Si, and another said gate electrode region has a different work-function from that of said at least one gate electrode region,

the act of forming said channel region comprising forming at least one channel portion under said at least one gate electrode region.

~~and~~

~~forming at least one transistor adjacent to the photo-conversion device, the act of forming the transistor comprising forming a channel region and forming a gate electrode over the channel region, the act of forming the gate electrode comprising forming the gate electrode having a length extending from a source/drain region to the photo-conversion device and forming at least one gate electrode region extending the length of the gate electrode and having a substantially uniform dopant type and concentration and a work-function greater than a work-function of n+ Si, the act of forming the channel region comprising forming at least one channel portion under the at least one gate electrode region.~~

53. (Original) The method of claim 52, wherein the act of forming the first transistor comprises forming a transfer transistor for transferring photo-generated charge from the photo-conversion device to a floating diffusion region.

54. (Currently amended) The method of claim 52, wherein ~~the act of forming the~~ at least one gate electrode region comprises forming a layer of mid-gap material.

55. (Original) The method of claim 54, wherein the act of forming the layer of mid-gap material comprises forming the layer of mid-gap material selected from the group consisting of: $Si_{1-x}Ge_x$, TiN/W, Al/TiN, Ti/TiN, and TaSiN.

56. (Original) The method of claim 55, wherein the act of forming a layer of mid-gap material comprises forming a layer of $Si_{1-x}Ge_x$, wherein a mole fraction of Ge is approximately 0.4.

57. (Original) The method of claim 56, wherein the act of forming a layer of $Si_{1-x}Ge_x$ comprises doping the layer of $Si_{1-x}Ge_x$ to one of a first or second conductivity type.

58. (Currently amended) The method of claim 52, wherein ~~the act of forming the~~ at least one gate electrode region comprises forming a layer of degenerately doped p+ polysilicon.

59. (Currently amended) The method of claim 52, wherein ~~the act of forming the~~ at least one gate electrode region comprises forming a layer of lower doped polysilicon of a first or second conductivity type.

60. (Currently amended) The method of claim [[52]] <u>59</u>, wherein the act of forming the layer of lower doped polysilicon comprises forming the layer of lower doped polysilicon having a dopant profile allowing for at least partial depletion of the at least one gate electrode region.

61. (Original) The method of claim 60, wherein the act of forming the layer of lower doped polysilicon comprises doping the polysilicon with indium.

62. (Original) The method of claim 52, wherein forming the channel region comprises forming at least one portion of the channel region having approximately no active dopant concentration.

63. (Withdrawn) The method of claim 52, wherein the act of forming the gate electrode comprises forming first and second gate electrode regions, and wherein the act of forming the channel region comprises forming first and second channel portions below the first and second gate electrode regions, respectively.

64. (Withdrawn) The method of claim 63, wherein the act of forming the first and second gate electrode regions comprises forming the first and second gate electrode regions such that each of the first and second gate electrode regions extends over an active area by a different distance.

65. (Withdrawn) The method of claim 63, wherein the first and second gate electrode regions are each formed having different work-functions, each work-function being greater than a work-function of n+ Si.

66. (Withdrawn) The method of claim 52, wherein the act of forming the gate electrode comprises forming first, second, and third gate electrode regions, and wherein the act of forming the channel region comprises forming first, second, and

third channel portions below the first, second, and third gate electrode regions, respectively.

67. (Withdrawn) The method of claim 66, wherein the first gate electrode region is formed between the second and third gate electrode regions, and wherein the second and third gate electrode regions are each formed over a respective area where an isolation region and an active region meet, and wherein at least one of the second and third gate electrode regions has a work-function greater than a work-function of n+ Si.

68. (Withdrawn) The method of claim 67, wherein the second and third gate electrode regions are formed having a same work-function.

69. (Withdrawn) The method of claim 67, wherein the act of forming the second and third channel portions comprises forming the second and third channel portions such that a doping concentration of at least one of the second and third channel portions is determined at least in part by the work-function of the respective gate electrode region.

70. (Withdrawn) The method of claim 52, further comprising:

forming a second transistor, the act of forming the second transistor comprising forming at least one second transistor gate electrode region having a work-function greater than a work-function of n+ Si.

71. (Withdrawn) The method of claim 70, wherein the at least one second transistor gate electrode region is formed of the same material as the at least one gate electrode region.

72. (Canceled)

73. (Withdrawn) A method of forming a pixel cell, the method comprising:

forming a photo-conversion device; and

forming a transistor adjacent to the photo-conversion device, the act of forming the transistor comprising forming a gate electrode overlying a channel region, the act of forming the gate electrode comprising forming a gate electrode having a length extending from a source/drain region to the photo-conversion device, the gate electrode comprising at least two gate electrode regions, each gate electrode region extending the length of the gate electrode and having a substantially uniform dopant type and concentration, wherein at least one of the gate electrode regions has a work-function greater than a work-function of n+ Si, the act of forming the channel region comprising forming respective portions below each gate electrode region.

74. (Withdrawn) The method of claim 73, wherein the act of forming the at least two gate electrode regions comprises forming each of the gate electrode regions extending over an active area by a different distance.

75. (Withdrawn) A method of forming a pixel cell, the method comprising:

forming a photo-conversion device; and

forming a transistor adjacent to the photo-conversion device, the act of forming the transistor comprising forming a gate electrode overlying a channel region, the act of forming the gate electrode comprising forming first, second, and third gate electrode regions, wherein the first gate electrode region is formed between the second and third gate electrode regions, and wherein the second and third gate electrode regions are each formed over a respective area where an isolation region and active region meet, and wherein at least one of the second and third gate electrode regions is formed having a work-function greater than a work-function of n+ Si, the act of forming the channel region comprising forming first, second, and third portions below the first, second, and third gate electrode regions, respectively.

76. (Withdrawn) The method of claim 75, wherein the second and third gate electrode regions are formed having a same work-function.

77. (Withdrawn) The method of claim 75, wherein the doping concentration of at least one of the second and third channel portions is determined at least in part by the work-function of the respective gate electrode region.